shot (as imagined by the late Prof. Marreco and Mr. D. P. Morrison), or by a fall of roof, a train of mine waggons that has just passed, or any other accidental circumstance, and subsequently carried past the mouth of the shot-hole at the instant the flame issues from it."

Immediately after the passage quoted above the Commissioners proceed to say :—

"The following facts relating to the part played by dust in coal-mine explosions may, however, now be regarded as conclusively established :—

"1. The occurrence of a blown-out shot in working-places *where very highly inflammable coal-dust exists in great abundance*, may, even in the total absence of fire-damp, possibly give rise to violent explosions, or may at any rate be followed by the propagation of flame through very considerable areas, and even by the communication of flame to distant parts of the workings where explosive gas-mixtures, or dust-deposits in association with non-explosive gas-mixtures, exist."

"2. The occurrence of a blown-out shot in localities *where only small proportions of fire-damp* exist in the air *in the presence of even comparatively slightly inflammable or actually non-inflammable, but very fine, dry, and porous dusts* may give rise to explosions the flame from which may reach to distant localities, where either gas accumulations or deposits of inflammable coal-dust may be inflamed, and may extend the disastrous results to other regions."

This has the appearance of conceding all that is asked, but when read in the light of the first quotation it leaves the matter in considerable doubt. Indeed, it was stated at the inquest on Altofts explosion that the proprietors of that colliery had not gathered from the Commissioners' Report that they were running any risk of an explosion, such as the one that happened ; and at the inquest on Elemore explosion, which has been adjourned until the 18th inst., Mr. Lishman, the manager, gave utterance to similar sentiments. Be this as it may, it is obvious that legislative measures ought to be adopted without further delay, with the object of rendering the recurrence of coal-dust explosions impossible for the future. In providing against them it must also be recollected that a local explosion of fire-damp, such as the one which originated Mardy explosion, produces exactly the same result as a blown-out shot fired under the most favourable conditions imaginable.

Cardiff, January 5 W. GALLOWAY

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## The Cambridge Cholera Fungus

IN your issue of December 23 (p. 171) appears a letter from Dr. E. Klein, in which that gentleman attempts to show that the micro-organisms found by Dr. Graham Brown, Mr. Sherrington, and myself in the substance of the mucous membrane of the small intestine in cases of *Cholera asiatica* are nothing more than "common mould (probably aspergillus)," which has grown on and into the tissue during the process of hardening. We were and are, however, perfectly well acquainted with the fact that imperfectly preserved animal tissues are liable to be invaded by various forms of fungi, and took, therefore, precautions which we believe to be ample to prevent such contamination of our material. Moreover, the presence of the micro-organisms in certain parts of the tissues only, their absence in others or on the surface of the specimens, the fact that their presence in the part is accompanied by anatomical changes which could not have taken place during the process of hardening, and, most of all, the characters of the micro-organisms themselves, render such an hypothesis as that brought forward by Dr. Klein absolutely unacceptable.

It is unnecessary for me to answer all the arguments advanced by Dr. Klein in support of his views on this subject. They prove nothing more than that fungi grow on and in animal tissues which are not adequately preserved—a fact which no one will doubt. That, on the other hand, the micro-organisms found by us are of this nature is a matter which neither Dr. Klein nor any other person who is unacquainted with the facts is in a position to decide. Since a short preliminary account only of the work done by Dr. Graham Brown, Mr. Sherrington, and myself, on the pathology of cholera has as yet been published, Dr. Klein has not before him the facts on which alone a decision of any value is possible. CHARLES ROY

Pathological Laboratory, New Museums, Cambridge
December 30, 1886

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## An Error in Maxwell's "Electricity and Magnetism"

THE criticism of Mr. McConnel upon Maxwell's derivation of the inductive action of currents from the principle of energy is perfectly correct. It is inconsistent with the experimental facts appealed to by Mr. McConnel and Mr. Maxwell's own treatment of the field as the seat of electro-kinetic energy.

In the excellent treatise of Messrs. Mascart and Joubert, a similar misleading appeal is made to Helmholtz's proof, and I have little doubt that Maxwell has correctly stated it. I should be inclined to think that the existence of the energy of the field was not distinctly present to Helmholtz's mind.

Maxwell, as is well known, by an ingenious application of Lagrange's equations of motion, proves that, in the case of two currents, this electro-kinetic energy $T_e$ is given by the equation—

$$T_e = \tfrac{1}{2}(L_1 i_1^2 + M i_1 i_2 + L_2 i_2^2),$$

where $M = \iint \frac{\cos \epsilon}{r} ds ds'$ taken round both circuits, and $L_1$ and $L_2$ are similar expressions for the separate circuits.

I believe, though I dare not trespass upon your space to give the reasoning *in extenso*, that this result may be obtained somewhat more simply and without the use of the Lagrangean equations, a treatment which has the disadvantage of assuming the electric co-ordinates $y_1$ and $y_2$, the currents being $\dot{y}_1$ and $\dot{y}_2$ Then the equation of energy becomes

$$A_1 i_1 + A_2 i_2 = \frac{dT_e}{dt} + \frac{dT_m}{dt} + R_1 i_1^2 + R_2 i_2^2,$$

where $T_m$ is material kinetic energy, and $\frac{dT_m}{dt} = i_1 i_2 \frac{dM}{dt}$ supposing the circuits rigid. Therefore

$$A_1 i_1 + A_2 i_2$$

$$= i_1 \left\{ \frac{d}{dt}(L_1 i_1 + M i_2) + R_1 i_1 \right\} + i_2 \left\{ \frac{d}{dt}(L_2 i_2 + M i_1) + R_2 i_2 \right\},$$

reducing to Mr. McConnel's equation, when the currents are constant.

In the case of two circuits thus moving in connection with their batteries we may infer that $A_1$ and $A_2$ must be such functions of $i_1$ and $i_2$, and the coefficients of configuration, that, when the suffixes are interchanged in the expression for $A_1$, that for $A_2$ must result, and *vice versâ*. If this be so, then the aforesaid equation necessitates the separate equations—

$$A_1 = \frac{d}{dt}(L_1 i_1 + M i_2) + R_1 i_1 \ ;$$

$$A_2 = \frac{d}{dt}(L_2 i_2 + M i_1) + R_2 i_2.$$

Or Maxwell's equations are obtained without the use of Lagrange. HENRY W. WATSON

Berkeswell Rectory, near Coventry

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## The Manipulation of Glass containing Lead

IN a note on this subject in NATURE (Dec. 16, p. 150), Mr. H. G. Madan has made a suggestion which is likely to be very valuable to those who require to manipulate "combustion-tubing" before the blow-pipe. But, in proposing the employment of oxygen in place of air to produce flames for heating glass containing lead, Mr. Madan introduces a refinement which is unnecessary ; for lead-glass may be quite as easily manipulated in flames produced by plain air and gas as soda-glass itself. The pointed flame should be employed for small objects, and the oxidising brush-flame in the case of larger objects. By the oxidising brush-flame, however, I do not mean the brush-flame as ordinarily employed, but one to which the air is supplied liberally through an air-tube without any contraction at its end, and at a steady pressure from a good blower ; care being taken, on the other hand, not to introduce such an excess of air as to reduce the temperature of the flame.

In his note, Mr. Madan quotes me as saying, in the "Methods of Glass-blowing," that the reduction of lead-glass may be prevented or remedied by holding the glass a little in front of the visible flame, with the comment that there is hardly enough heat in that region to do all that is required in the manipulation

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of the glass. I hope he will excuse me if I point out that in this he hardly does me justice; for, although words in the above sense are to be found on p. 18, they occur only towards the end of the preliminary treatment of the subject, attention is at once called to the objections to the method, and they are followed by a full account (with references to diagrams) of the method of adjusting the supplies of air and gas so as to produce flames *within which* lead-glass may be sufficiently heated without reduction.

I have ventured to trespass on your space to this extent, because, for various reasons, I have come to the conclusion that lead-glass is distinctly the best glass for beginners to work with, and therefore I am anxious to correct the widespread and mistaken idea that its manipulation is very difficult, and requires special appliances. W. A. SHENSTONE

Clifton, December 28

### Pyrometers and Fusion-Points

I READ with much interest the letter from Naples of Dr. H. J. Johnston-Lavis, and beg to offer a few suggestions in answer to his inquiries. I have done much work with pyrometers, and for my purposes have used Siemens's water pyrometer with satisfaction.

It occurs to me, however, that the pyrometer most suitable for the volcanic lava investigations proposed by Dr. Johnston-Lavis would be either Siemens's electrical pyrometer, or the one recently introduced by Messrs. Murries and Co., 45, West Nile Street, Glasgow. It would seem that, with the latter, observations can be readily taken at a considerable distance from the pyrometer, so that the pyrometer stem might possibly be lowered into the crater, and readings of the internal temperatures taken at various depths, and possibly of the contained lava also.

With regard to the fusing points of various substances, reference may be made to the recent careful researches on this subject of Dr. Thomas Carnelley and Prof. W. C. Williams.

THOS. ANDREWS

Wortley Iron Works, near Sheffield, January 4, 1887.

### Electricity and Clocks

THE exact combination about which Mr. Wilson inquires is already in existence: it can be seen at 2, Garfield Buildings, Gray's Inn Road, in the Jensen electric bell factory. The arrangement used by Mr. Jensen—and it seems to me preferable to that suggested by Mr. Gardner—is to cause the hammer of the small clock to make electric contact in the circuit of the distant large bell as it rises in preparation for striking the blow upon its own small bell. With a rubbing contact the action is perfectly certain. SILVANUS P. THOMPSON

City and Guilds Technical College, Finsbury

### Barnard's Comet

ON December 25, about 6h., with a binocular field-glass, power about 4, I noticed a third tail to this comet between the other two. It was extremely faint, but 6° long, reaching to 11 Aquilæ. The principal tail was reduced to 10° in length, and was far more conspicuous than this shorter, though much broader, tail. The shortest tail, though actually much brighter than this latter, was very indistinct with these field-glasses, being best seen with the telescope, power 20, whereas the middle tail was not distinctly visible therewith, although it showed an evident dark space immediately preceding the principal tail. With the naked eye I could see the long tail only. The head was about as bright as δ Aquilæ. T. W. BACKHOUSE

Sunderland, December 29, 1886

### Meteor

I HAVE just seen a very beautiful meteor about the size of Sirius. The local time was within a minute or two of half-past 10. It started out between Pollux and the star-cluster in Cancer, and fell rather slowly in the direction of Regulus, going out before it reached that star. It had a trail, which vanished with it. The sky had just cleared after a thunderstorm.

Sidmouth, December 28 J. M. H.

### Red Sunsets and New Zealand Eruptions

NEW ZEALAND eruptions have not the projectile force to cause red sunsets. Singularly, the very same current of ideas expressed by Prof. Newcomb in NATURE, vol. xxxiv. p. 340, occurred to the writer, when in Australian waters the June previous, on the deck of the P. and O. steamer *Ballaarat*, off the Great Bight, on noticing a peculiarly red northerly sunset. The newspapers at King George's Sound were full of accounts of the magnitude of the eruption of Tarawera, and it must be the fine dust from New Zealand that has passed overhead.

The atmosphere of Australia, it may be mentioned, is one of the clearest, "exceptionally free," as Prof. Newcomb puts it, "from vapours or other attenuated matter," and in which volcanic dust would tell immediately.

This suggestion disappeared at once on getting to the actual site of the New Zealand eruption, only six weeks after it had occurred, and on seeing the limited area covered with mud—a mere nothing compared with the vast stretch of country in the North Island passed through. As there was not a trace of its effects till within eight miles of the foot of Tarawera, it was simply ridiculous to suppose that any of the dust had invaded the higher atmosphere.

Besides this, the boundary of the cloud of atmospheric disturbance was distinctly seen, and the altitude placed by none of the spectators to be above 12,000 feet.

The explosion at Tarawera appears to have been merely one of superheated steam. It was different in the case of Krakatão, where the initial force had much more of the character of an explosion of nitroglycerine than of high-pressure steam, as the matter was stated to have been projected at least 40,000 feet into the air.

The magnitude of the New Zealand eruption could only be felt after getting well within the diameter of sixteen miles on which the mud fell, plastering hill and dale, evenly, of a dull gray, eighteen inches thick. Exterior to this it possessed none, and the distant results evidently were infinitesimal.

The writer also saw the "green sun" from the south of India, where it lasted for days, and has no doubt that this phenomenon was due to the dust from Krakatão, such an appearance having never been even faintly approached, before or since, from ordinary natural causes, and more impressive, because unaccounted for, than a total eclipse of the sun.

India, November 26, 1886 A. T. FRASER

## THEODOR VON OPPOLZER

THEODOR VON OPPOLZER, one of the most eminent of modern astronomers, died at Vienna on December 26, 1886. He was the only son of Johannes von Oppolzer, the famous pathologist of Vienna, and was born on October 26, 1841. In accordance with the wish of his father, he studied medicine, and took his doctor's degree in 1863. From early youth he had shown great interest in astronomy, and, soon after taking his degree, he caused an observatory to be built at his own expense, and resolved to devote himself wholly to his favourite science. In 1866 he began to lecture at the University of Vienna, on theoretical astronomy, and he was soon promoted to the position of full Professor in his department. In 1870 he was asked by his Government to take charge of the operations for determining the length of a degree in Austria, and to this task he applied himself with so much energy that all the necessary observations were by and by completed, although his results have not yet been published.

Oppolzer distinguished himself in all departments of astronomical science. One of the most important of his writings was his "Lehrbuch zur Bahnbestimmung der Kometen und Planeten," a work which has already become classical. He had hoped to place the theory of the moon on a new basis, but his labours in connection with this subject were not finished at the time of his death. On his death-bed he corrected the last proof-sheets of his "Canon der Finsternisse," in which he calculates all the eclipses of the sun and moon which have taken place, or which have yet to take place, between the years B.C. 1500 and A.D. 2000.

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